

PATENT ABSTRACTS OF JAPAN

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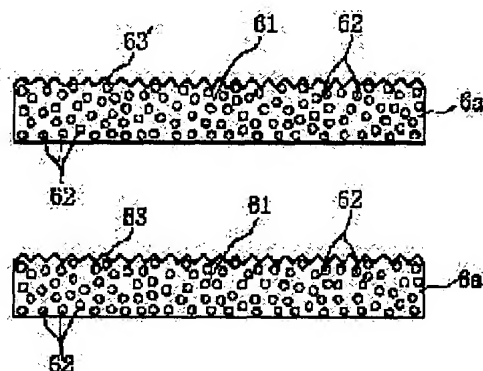
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(54) LIGHT-DIFFUSING SHEET

(57)Abstract:

PURPOSE: To provide a light-diffusing sheet which can satisfy all requirements such as high luminance and high diffusing property and a thin sheet.

CONSTITUTION: This sheet consists of a thermoplastic transparent plastic sheet 61 in which transparent acryl beads 62 having a different refractive index than that of the plastic sheet 61 are uniformly dispersed. The surface of the transparent plastic sheet 61 is embossed. Since transparent beads (diffusing material) 62 are uniformly dispersed in the sheet base body 61, light is enough diffused during passing through the sheet base body 61. Moreover, light is further diffused on the surface which is subjected to embossing treatment. Thus, diffusion performance can be improved without decreasing the luminance. Moreover, the sheet can be made thin compared with the conventional structure of a sheet produced by applying a diffusing layer on a sheet base body 61.



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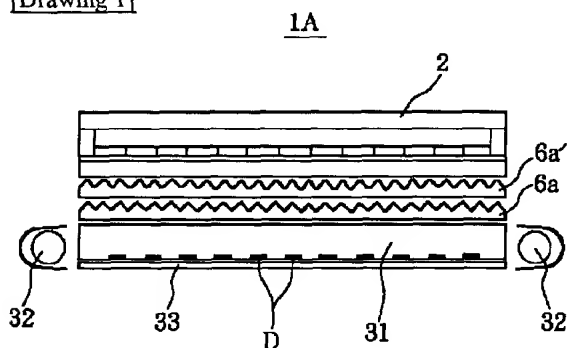
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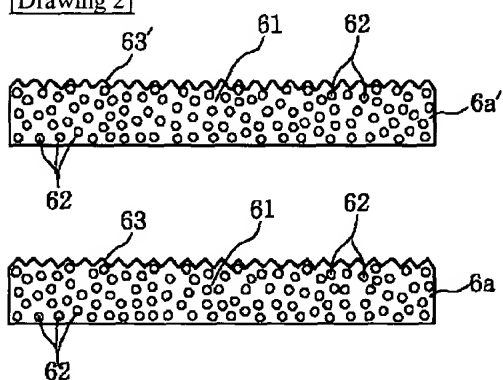
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DRAWINGS

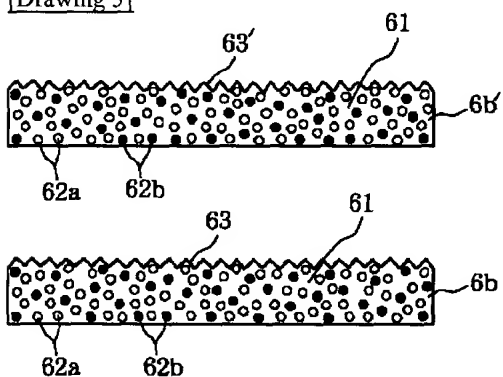
[Drawing 1]



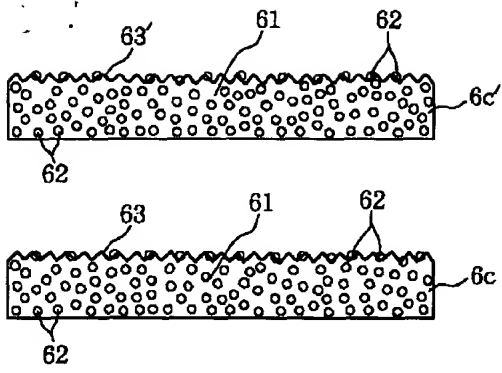
[Drawing 2]



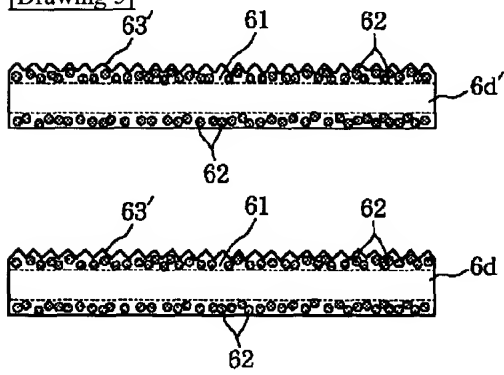
[Drawing 3]



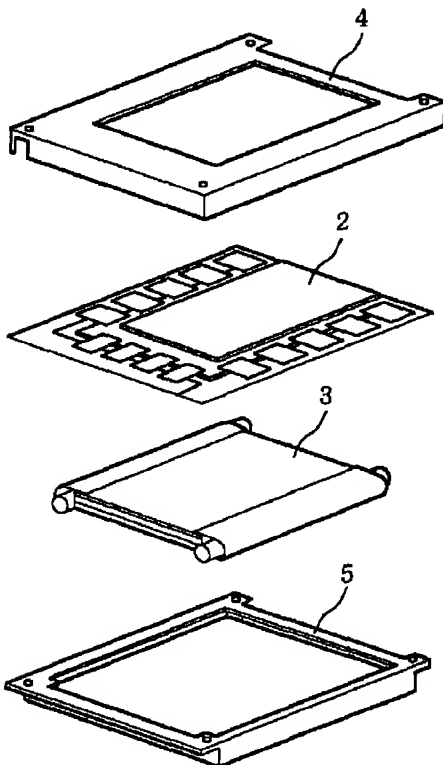
[Drawing 4]



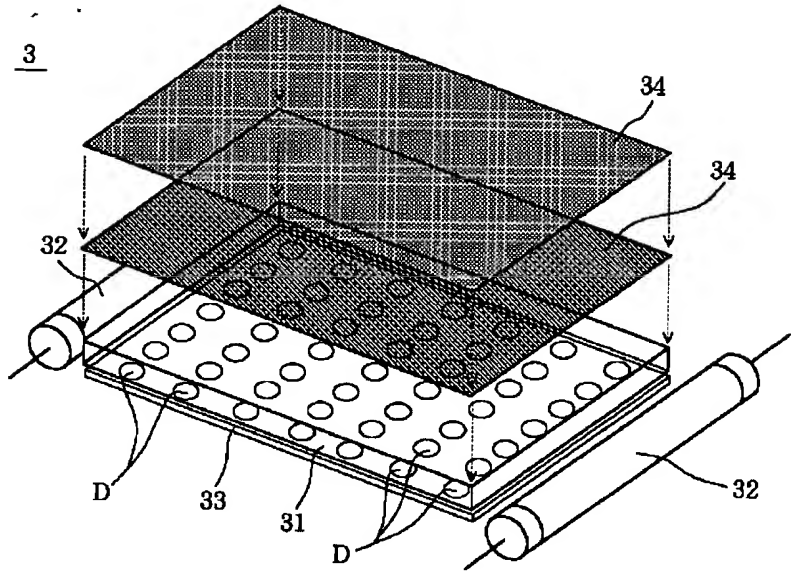
[Drawing 5]



[Drawing 6]



[Drawing 7]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical diffusion sheet used for the LCD of a back light method etc.

[0002]

[Description of the Prior Art] adoption of the back light which contrast of a LCD is clear and improves an occurrence of TFT liquid crystal panel which can be displayed high-speed, and visibility -- now -- a thin shape -- it is the favorite of lightweight display And a word processor, a notebook sized personal computer, portable television, etc. have spread using this. As drawing 6 is a decomposition perspective diagram showing the configuration of the LCD of a back light method and is shown in this drawing, a back light (source of a back light) 3 is arranged behind the TFT liquid crystal panel 2, and, as for this kind of LCD 1, it has come to pinch these with the front chassis plate 4 and the rear chassis plate 5.

[0003] The above-mentioned TFT liquid crystal panel 2 is constituted from a liquid crystal layer, an orientation layer, a TFT array substrate, a polarizing plate, the wiring printed circuit board, etc. by the laminating, and a light-filter substrate is also further added to an electrochromatic display panel. Moreover, as expanded and shown in drawing 7, the outline configuration of the above-mentioned back light 3 is carried out from the light guide plate 31 which consists of a polymethylmethacrylate plate, the white fluorescent lamps (three wave photogenesis type cold cathode tube) 32 and 32 arranged on both the sides of a light guide plate 31, the reflective sheet 33 which consists of an opaque polyethylene-terephthalate film arranged on the rear-face side of a light guide plate 31, and the optical diffusion sheets 34 and 34 of two sheets arranged on the front-face side of a light guide plate 31. The countless dot patterns D and D and -- are printed by the rear face of the above-mentioned light guide plate 31 using the ink of an optical diffusibility.

[0004] In LCD 1 of the above-mentioned configuration, in order to illuminate the TFT liquid crystal panel 2 by the back light 3 at the time of an operation, put in the light of the white fluorescent lamps 32 and 32 into a light guide plate 31 from the side of a light guide plate 31, and it is made to reflect with the reflective sheet 33, and with the surface optical diffusion sheets 34 and 34, a luminosity is uniformly carried out to the dot patterns D and D of the rear face on which each of functions as a source of the false diffused light, and And incidence of the light uniformly injected from the front face of the upper optical diffusion sheet 34 is carried out from the rear face of the TFT liquid crystal panel 2, and a liquid crystal layer is passed. Thus, it becomes the display of a transparency formula by seeing the light which passed the liquid crystal layer through a polarizing plate (a case the light filter and polarizing plate of an electrochromatic display panel).

[0005] By the way, in case the above-mentioned optical diffusion sheet 34 observes a liquid-crystal-display screen, it must be troubled by dot patterns D and D and the thing by which -- is checked by looking through TFT liquid crystal panel, and must be rich at a diffusibility in the grade from which uniform brightness is obtained on the front face of the optical diffusion sheet 34. On the other hand, however it may excel in the diffusibility, it cannot use for an electrochromatic display display in what has low brightness. After distributing transparent beads, such as an acrylic bead, in the liquefied organic macromolecule binder with which a refractive index is different and applying to one side or both sides of a transparent base material as it is in the inclination that the thing of high brightness is developed in connection with the spread of electrochromatic displays as latest optical diffusion sheet, for example, it is indicated by JP,5-73601,U, JP,6-67003,A, etc., what carried out [what] xeransis solidification and was made into the optical diffusion layer is known.

[0006]

[Problem(s) to be Solved by the Invention] however, with the above-mentioned conventional optical diffusion sheet Since a transparent bead is used as a dispersing agent, although it can respond to the request of a raise in brightness, by the transparent bead and the transparent base material Since a refractive-index difference is not large, in order to obtain sufficient diffusibility ability, [whether a transparent bead is included very so much and] Or although a diffusion layer must be made very thick, if it is going to aim at a resolution by the former When an optical diffusion sheet becomes good also very much, and possibility of starting a brittle fracture easily with the impact of external force becomes high and the cost of materials increases in the resolution by the latter, there is a possibility of causing the result contrary to the request of a raise in brightness and thin-shape-izing.

[0007] This invention was made in view of the above-mentioned situation, and aims at offering the optical diffusion sheet which can fill all demands of a raise in brightness, a raise in a diffusion, and thin-shape-izing.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the optical diffusion sheet according to claim 1 is characterized by giving the detailed irregularity manipulation among the front face of a transparent plastics sheet, and the rear face in one [at least] field while it is unevenly distributed to the thickness orientation, distributed inclusion is carried out and the single kind with which a refractive index is different from this transparent plastics sheet, or two or more sorts of transparent beads become the interior of a thermoplastic transparent plastics sheet uniformly.

[0009]

[Function] When according to the configuration according to claim 1 light fully diffuses while passing through the interior of a transparent plastics sheet since the transparent bead (dispersing agent) contains inside the transparent plastics sheet, enhancement in diffusibility ability can be aimed at certainly, without sacrificing brightness, since it is further spread on the front face on which the detailed irregularity manipulation was given. In addition, thin shape-ization can be attained compared with the configuration which applies a diffusion layer on a sheet base material like before.

[0010]

[Example] Hereafter, the example of this invention is explained with reference to a drawing.

◇ The cross section and the drawing 2 showing the outline configuration of the LCD of the back light method with which it comes to incorporate the optical diffusion sheet whose 1st example view 1 is the 1st example of this invention are a cross section expanding and showing the configuration of this optical diffusion sheet. Since it is only the configuration of optical diffusion sheet 6a of a two sheet couple, and 6a', in drawing 1, about the same component as a prior art (the drawing 6 and drawing 7), the place where LCD 1A concerning this example is different from conventional LCD 1 attaches the same sign, and omits the explanation. As optical diffusion sheet 6a of this example and 6a' are shown in drawing 2, in this sheet base material 61, the transparent beads 62 and 62 and -- from which a refractive index is different have come to contain in the distributed status uniformly, and, as for the front face, embossing of 1-50 micrometers of concavo-convex mean pitches is performed to the interior of the sheet base material 61 which consists of thermoplastic transparent plastics. Of this embossing, the irregularity 63 of a fresnel prism configuration is formed in the front face of one optical diffusion sheet 6a, and concavo-convex 63' of a smooth-surface configuration is formed in the front face of optical diffusion sheet 6a' of another side, respectively. in addition -- this example -- although optical diffusion sheet 6a of a fresnel prism configuration was arranged to the light guide plate 31 side and the front face arranged optical diffusion sheet 6a' of a smooth-surface configuration to the TFT liquid crystal panel 2 side, reverse arrangement is also easy to be natural [a front face]

[0011] Although transparency is good and the polycarbonate (refractive indexes 1.59-1.60) with a thickness [a certain] of 100-500 micrometers of a mechanical strength is desirable as the above-mentioned sheet base material 61 Besides this, polyethylene, a chlorinated polyethylene, polypropylene, A polybutylene terephthalate, a polyamide, a polyacetal, a polyether, Polystyrene (refractive indexes 1.59-1.60), a polyester amide, A polyphenylene sulfide, polyether ester, a polyvinyl chloride, A polymethacrylic acid ester, polyacrylic ester, a polymethyl methacrylate (refractive index 1.49), Films, such as polyvinyl acetate, an ethylene-vinyl acetate copolymerization resin, a vinyl chloride-vinylidene-chloride copolymerization resin, a polyvinyl butyral, a polyvinylidene fluoride, and a styrene-acrylic copolymerization resin, can be used.

[0012] As the above-mentioned transparent bead 62, a mean particle diameter is 1-25 micrometers, for example, transparent inorganic beads, such as transparent organic beads, such as an acrylic bead (refractive index 1.49), a polypropylene bead, a polystyrene bead (refractive indexes 1.59-1.60), a polyethylene bead, a polyvinyl chloride bead, a polyvinyl-fluoride bead, and a polyurethane bead, and various glass beads (refractive indexes 1.45-1.96), a silica (refractive index 1.487), a calcium-carbonate bead (refractive index 1.6585), an alumina bead (refractive indexes 1.76-1.77) In addition, unless the combination of the sheet base material 61 and the transparent bead 62 is the same refractive index mutually, it is arbitrary, and it is not asked whether which refractive index is size.

[0013] O Make reference about the comparative experiments which evaluates the performance of a comparative experiments next optical diffusion sheet 6a of this example, and 6a' and which went to accumulate. After distributing uniformly 7 micrometers of mean particle diameters, and the melting acrylic grain of 30 % of the weight of compounding ratios in a melting polycarbonate, while extrusion molding of this mixed melt was carried out, embossing was performed to the front face, the optical diffusion film of a long picture with a thickness of 140 micrometers was created, this was judged in 196mm of form widths, and vertical dimension of 135mm, and optical diffusion sheet 6a of this example and 6a' (drawing 2) were obtained. The refractive index of about 1.49 and the sheet base material (polycarbonate) 61 of the refractive index of the solidified acrylic bead was about 1.59-1.60.

[0014] On the other hand, when removing the point of having used the glass bead with near polycarbonate and refractive index, instead of the acrylic bead as an example 1 of a comparison, the optical diffusion sheet of the two sheet couple which is the same configuration [as this example] same configuration was created. Moreover, when the acrylic bead removed the point which is unevenly distributed in the front-face side as an example 2 of a comparison, the optical diffusion sheet of the two sheet couple which is the same configuration [as this example of an example] same configuration was created.

[0015] And three kinds of back lights were manufactured using each optical diffusion sheet of an example, the example 1 of a comparison, and the example 2 of a comparison. Three kinds of back lights are mutually the same if an optical diffusion sheet removes a point different like the above. That is, the light guide plate (polymethylmethacrylate plate) 31 and the reflecting plate (opaque polyethylene-terephthalate film) 33 which each is 3.5mm in outer diameter, and two white fluorescent lamps (cold cathode tube) 32 and 32 with a length of 196mm are used at a time, and have the dot patterns D and D of an optical diffusibility and -- at the rear face as a flanking window are also the thing of the same configuration same configuration mutually. The comparative experiments (performance-evaluation examination) of an optical diffusion sheet drove two white fluorescent lamps of a flanking window by the inverter of direct-current 12V, and performed them by making light emit by 500-1,000Hz alternating current.

[0016] The performance evaluation like the following table was obtained as a result of the comparative experiments.

	実施例	比較例 1	比較例 2
明るさ (cd/m ²)	1 5 0 0	1 2 0 0	1 5 0 0
射出光範囲 (°)	1 3 0	1 0 0	9 0
ドット見え	◎	△	×

About brightness, optical diffusion sheet 6a of this example and 6a' are equivalent to the example 1 of a comparison, and have a two or more examples [of a comparison] performance. Moreover, about the injection light domain which leads to the quality of visibility, since a diffusing power is high, it has a performance beyond the example of a comparison. Furthermore, about dot visibility, it has a performance to the extent that it does not become a thing compared with the example of a comparison.

[0017] Enhancement in diffusibility ability can be aimed at certainly, without sacrificing brightness so that clearly from the result of an above-mentioned comparative experiments, since it is further spread on the front face on which embossing when light fully diffuses while passing through the interior of a sheet base material since the transparent bead (dispersing agent) contains uniformly inside the sheet base material according to the configuration of this 1st example was performed. In addition, thin shape-ization can be attained compared with the configuration which applies a diffusion layer on a sheet base material like before.

[0018] < 2nd example view 3 is the cross section expanding and showing the configuration of optical diffusion sheet 6b which is the 2nd example of this invention, and 6b'. Two kinds of transparent beads (an acrylic bead and alumina bead) 62a and 62b with which a refractive index is mutually different inside [optical diffusion sheet 6b of this example and 6b' consist of a polycarbonate with a thickness of 150 micrometers] the sheet base material 61 (refractive indexes differ of course in the sheet base material 61) have come to contain in the distributed status uniformly, and same embossing is performed with the 1st example having described to the front face.

[0019] According to the configuration of this 2nd example, the same effect can be acquired with having described the 1st example. In addition, if two kinds of transparent beads with which a refractive index is mutually different are mixed suitably, the enhancement in fast of diffusibility ability is expectable. In addition, the transparent bead to mix is good also not only as two kinds but three kinds or more.

[0020] < 3rd example view 4 is the cross section expanding and showing the configuration of optical diffusion sheet 6c which is the 3rd example of this invention, and 6c'. In optical diffusion sheet 6c of this example, and 6c', the transparent beads (acrylic bead) 62 and 62 and -- are sticking out of the front face where embossing is performed. Points other than this, it is the same as that of optical diffusion sheet 6a of the 1st example, and 6a' (drawing 2). In addition, as technique of making a transparent bead projecting from an embossing front face, it adheres uniformly, a transparent bead is put on an embossing roller, and there are technique of making a transparent bead imprinting to the sheet base-material 61 side simultaneously with embossing, the technique of making it adhere to an embossing front face by the spray, etc.

[0021] Since the transparent beads 62 and 62 and -- contain uniformly inside the sheet base material 61 according to the configuration of this 3rd example Enhancement in diffusibility ability can be aimed at certainly much more, without sacrificing brightness, since light fully diffuses, it is spread also on the front face on which embossing was performed and it is further spread also by the transparent beads 62 and 62 and -- which have been projected from the front face, while passing through the interior of the sheet base material 61.

[0022] < 4th example view 5 is the cross section expanding and showing the configuration of optical diffusion sheet 6d which is the 4th example of this invention, and 6d'. The place where optical diffusion sheet 6d of this example and 6d' are different from optical diffusion sheet 6a of the 1st above-mentioned example, and 6a' As opposed to distributed inclusion of the transparent beads (acrylic bead) 62 and 62 and -- being carried out uniformly inside the sheet base material (polycarbonate) 61 in the 1st example The transparent beads 62 and 62 and -- are made unevenly distributed in the surface section (20 micrometers) and the rear-face section (20 micrometers) of the sheet base material 61 in optical diffusion sheet 6d of this example, and 6d'. It is the point that the transparent beads 62 and 62 and -- were made not to exist in the pars intermedia (100 micrometers) to the thickness orientation of the sheet base material 61. As the production technique of optical diffusion sheet 6d of this example, and 6d', there are a coextrusion process, a laminating embosser, a dipping method, etc., for example.

[0023] Since it is spread, the light diffused in the rear-face section spreading the transparent beads 62 and 62 and the pars intermedia in which -- does not exist, and going according to the configuration of this 4th example, uniform-ization of the region cloth of diffusibility ability can be attained.

[0024] As mentioned above, although the example of this invention has been explained in full detail with the drawing, a concrete configuration is not restricted to this example, and even if there is change of a design of a domain which does not deviate from the summary of this invention, it is included in this invention. For example, if liquid crystal is an electrochromatic display, it will not ask ** which is monochrome liquid crystal. Moreover, not only a side type but direct female mold is sufficient as a back light. If a white fluorescent lamp is a hot cathode type, it will not ask ** which is a cold cathode type. An optical diffusion sheet can be suitably fluctuated not only in a two sheet couple. The configuration of embossing is not limited to the thing of an example. Embossing may be performed not only to a front face but to a rear face, and may be performed to both sides. Moreover, the optical diffusion sheet of this invention is applicable not only to the back light of a LCD but OHP and the back

light of an electric-spectacular signboard.

[0025]

[Effect of the Invention] When light fully diffuses according to the optical diffusion sheet according to claim 1 while passing through the interior of a transparent plastics sheet since the transparent bead (dispersing agent) contains inside the transparent plastics sheet as explained above, enhancement in diffusibility ability can be aimed at certainly, without sacrificing brightness, since it is further spread on the front face on which the detailed irregularity manipulation was given. In addition, thin shape-ization can be attained compared with the configuration which applies a diffusion layer on a sheet base material like before.

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CLAIMS

[Claim(s)]

[Claim 1] The optical diffusion sheet characterized by giving the detailed irregularity manipulation to one [at least] field among the front face of the aforementioned transparent plastics sheet, and a rear face while it is unevenly distributed to the thickness orientation, distributed inclusion is carried out and the single kind with which a refractive index is different from this transparent plastics sheet, or two or more sorts of transparent beads become the interior of a thermoplastic transparent plastics sheet uniformly.

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